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New Approaches to Disaster Response

Tom Hayes, an intern at CHOH, uses a mobile GPS unit to gather data along the Potomac River for inclusion in the Geographic Information System being developed at the park.

We live on a planet composed of dynamic systems: it is a fact of life that many of our cultural and natural resources are at-risk for natural disasters. This is especially true when the transformative power of water is unleashed. Within minutes, culturally-significant areas can be seriously impacted at a recovery cost measured in millions of dollars. Due to a spate of bad weather early in 1996, the Chesapeake and Ohio Canal National Historical Park (CHOH) was inundated with a significant natural flooding event on the Potomac River and

GIS can also incorporate feature data recorded using Global Positioning System (GPS) satellites and software programs.

In the case of CHOH, an incident command team headed by Superintendent Doug Faris was quickly assembled to document and repair the damage. To facilitate this project, a GIS database is being created. A GIS database can provide precise locational information depicting park features and the extent of flood damage. GIS is also useful in showing relationships between natural and built resources while incorporating data from other pertinent sources such as the National Register of Historic Places, List of Classified Structures (LCS) records. (It is estimated that there are more than 1,250 structures and features eligible for National Register nomination on the C&O Canal.) A GIS database will also allow the response team to visualize alternative plans for restoring the park's cultural resources while maintaining a permanent record of recent and past flood damage or impacts. This is especially important when considering the total amount of funds that may be required to repair the flood damage: currently, the total estimate of flood-related damage exceeds \$25 million.

The Branch of Mapping and Information Technologies (BMIT), Heritage Preservation Services Division of the Cultural Resource Stewardship and Partnership Center offered its expertise to assist in these important efforts. BMIT is a national program which operates the only Cultural Resource Geographic Information System (CRGIS) facility within the National Park Service (NPS). Although CHOH had already started the process of establishing a GIS program prior to the floods of 1996, it was clear from the extent of the damage that this initial GIS effort needed outside assistance. Most recently, BMIT staff have been mapping various Civil War sites in the metro-Washington, DC area. It was an easy transition to begin mapping and recording data features along the towpaths of the Chesapeake and Ohio Canal.



This photograph of the Winch House at Feeder Dam #4 clearly shows flood damage sustained by a historic structure located on the towpath of the Chesapeake and Ohio National Historical Park.

its tributaries that did extensive damage to historically-significant property.

When a disaster occurs, it is standard operating procedure to assemble a disaster response team traditionally composed of park officials and an interagency task force. Recently, a nontraditional element has been added to the disaster response team: mapping professionals who specialize in geographic information systems (GIS). GIS consists of both hardware and software programs that combine spatial attributes and thematic map layers with information such as census records, tax parcel boundaries, natural resource data, historic maps, and historic site inventories.

Marie Frias is the GIS Coordinator at CHOH. The GIS program at CHOH is relatively new; a complete dataset for the length of the canal (184.5 miles) has not been developed and historical features have only lately been accurately mapped. In order to expedite this process, Nell Dieterle and Tina Kapka, GIS specialists for BMIT, have been assisting Frias and her small staff of rangers and volunteers with the tedious process of data development using existing United States Geological Service (USGS) digital data, as well as GPS mapping data. GPS spatial data gathered on-site with hand-held computers is downloaded into a PC-based program that is capable of processing the data into a baseline map. The particular GPS units used by Frias and BMIT are accurate (under the best circumstances) to within one meter. Any recorded discrepancies can be rectified when the data is downloaded and processed. Maps can then be "layered" with additional features and geographic-based information sets within a GIS software program.

Because of the large amount of data and the need to quickly repair this popular park, BMIT staff have also been working to process GPS spatial data at the CRGIS facility in Washington, DC. Once processed, this data will be input into the GIS database and then linked with the existing database (LCS) of the park's historic structures to provide a complete picture and permanent record of all historic properties within the park. Other

data, such as National Register properties, National Historic Landmarks, National Natural Landmarks, nearby NPS park units, CHOH park boundaries, roads, streams and elevation data will be processed by both Frias and BMIT staff and added to the park's GIS database. Peak flood data will be acquired from USGS flood gauge stations on the Potomac River. This data will help in the process of analyzing patterns of flood impacts over the years.

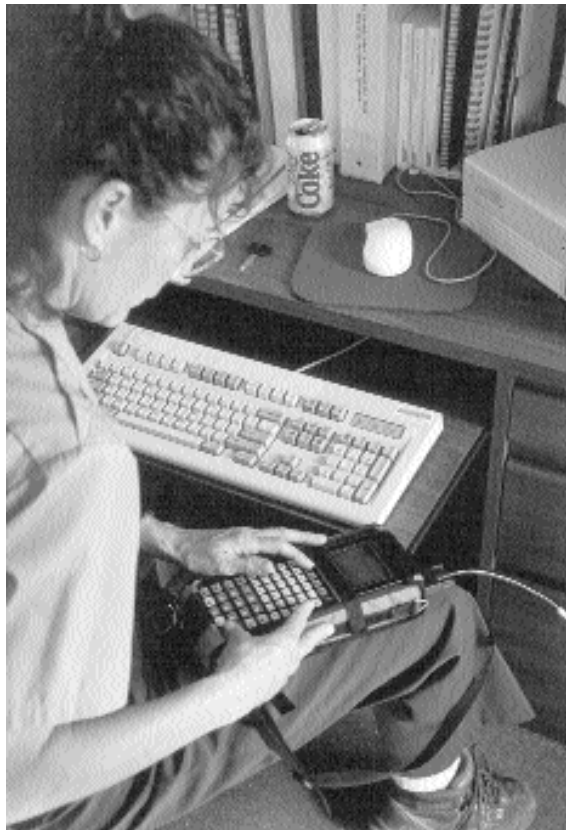
Park officials will be better able to monitor flood damage for both short-term and long-term resource planning, once the GIS database is operational. For example, the disaster response team will be directed to vulnerable areas based on direct geographic location. Also, the park will be in a position to react decisively to a wide range of problems that necessitate and require the use of maps and detailed databases. In the immediate short-term, the GIS database will assist in correcting recent flood damage by clearly establishing the park's natural and cultural features as well as its boundaries prior to the flood. In the long-term, through sustainability planning, the superintendent and other professionals will be prepared to address future emergencies. By establishing a GIS database now, data on the park's assets can be changed as the park evolves or as it is affected by natural disasters.

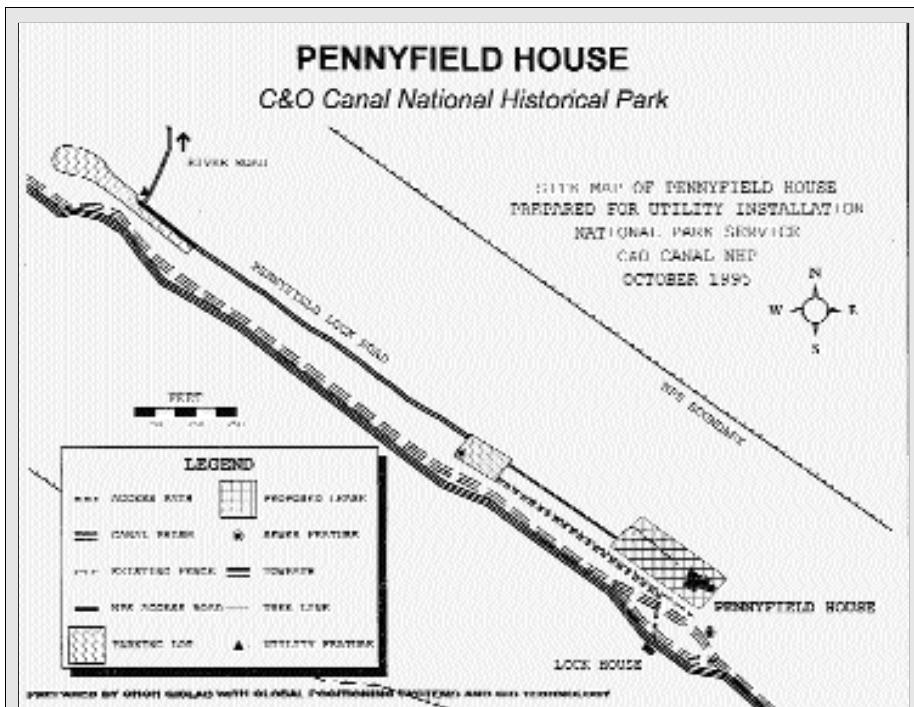
CHOH and BMIT share a common goal: creation of a strong GIS database foundation upon which to build for the future. It is clear that CHOH will continually experience damage to the park's assets from flooding. Recording the patterns of these historic and more recent floods will paint a picture of what resources will be required to maintain a level of services in a park that is enjoyed by untold numbers of annual visitors. <Image 5, map>

GIS offers many benefits to cultural resource managers. To that end, the CRGIS facility is working to provide the NPS with a standard GIS model that can be replicated throughout the park system to provide consistent results. GIS will aid the NPS and its cultural resource partners on many levels: identification of resources; creation of accurate maps showing both natural and cultural resources; establishment of databases to enhance park facilities maintenance; and future interpretive applications for enhanced visitor understanding of the cultural and natural landscape. Those who maintain and conserve the park's resources will, ultimately, be more effective.

The CRGIS facility maintains a number of goals to assist the NPS in fulfilling its mission. These include development of spatial (map-related) and digital applications to assist the parks with systematic resource inventories, resource pro-

Ranger Marie Frias prepares to download data features recorded along the CHOH historic towpath located at park headquarters. Downloaded data is then corrected and entered into the GIS database—a database which will, upon completion, encompass the entire 184.5 mile-long park.





CHOH started its GIS program in 1995—prior to the damaging floods that occurred in 1996. This map shows the historic Pennyfield House located within the park's boundary. The map was created using GPS in the field and GIS in the office; it was prepared as part of the historic structures leasing program to accurately display the location of the historic features, existing modern day features, as well as adjacent utility features. Utility companies will receive a copy of the map as a plan for consideration of on-site utility installation. Even if this area was completely flooded and its natural and historic features destroyed, the GIS system would help park officials to locate and reconstruct the relevant features.

tection and resource stewardship; encouraging GIS usage at the local park level; and providing GIS training to the parks and cultural resource partners. The CRGIS facility is a research environment where new applications and technologies are being explored to better interpret and protect the cultural landscapes and the vast natural resources whose care is entrusted to the NPS.

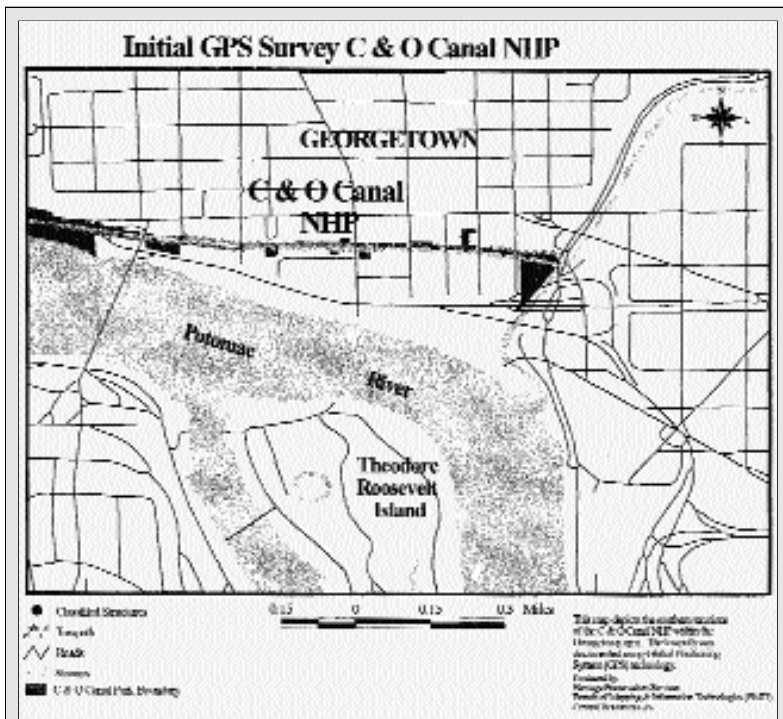
With assistance from CRGIS, state historic preservation offices are beginning to use GIS to automate resource inventories. A GIS database can contain a complete record of resources for any geographic area. By establishing such a database, cultural resource managers are better equipped to repair, maintain, and improve public facilities, especially when assessing damage from natural occurrences on a state-wide (macro) level to a localized disaster (micro) level. The BMIT/CRGIS facility has offered low-cost technical assistance to a wide-range of groups and organizations from local battlefield preservationists at Corinth, Mississippi to cultural resource managers along the Natchez Trace and at NPS sites from coast-to-coast. GIS will become more

prevalent at most of these sites. As John Knoerl, Acting Chief-BMIT states, "It is essential that GIS be thought of as a set of tools that can assist the preservationist in solving preservation problems. As GIS becomes more routine in historic preservation, it is likely that cartographic models that address the most common historic preservation problems in survey, planning, evaluation, registration, and protection will be developed and disseminated to others to use, adapt, and hopefully profit."

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A small section of the 184.5 mile-long C&O Canal NHP depicting the southern terminus in Georgetown. The towpath data was created using GPS technology by Nell Dieterle, Cartographer, and Tina Kapka, GIS Specialist for NPS, Heritage Preservation Services, Branch of Mapping and Information Technologies (BMIT).